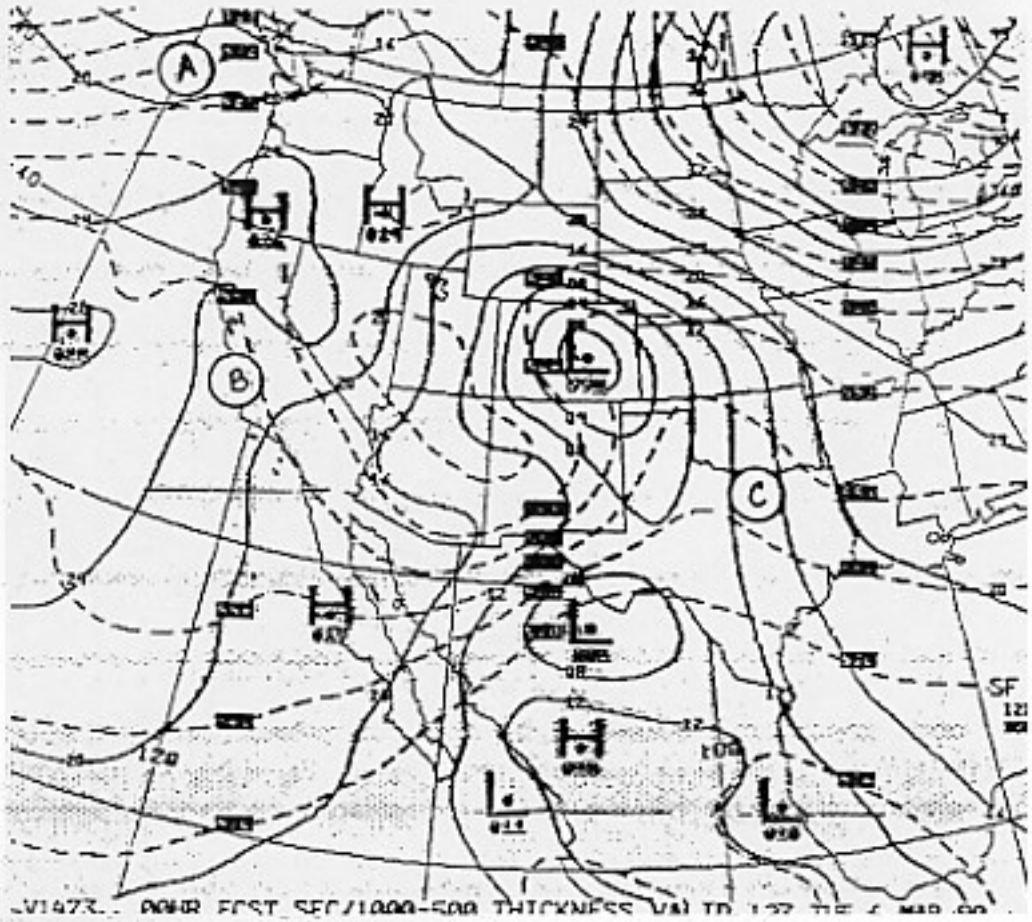
Atmospheric Physics II

4a. Determine the type and strength of advection.

Advection

- It is the horizontal transportation of any substance by the wind.
- 3 steps for determining the magnitude of advection
  - Step 1. Evaluate the direction and speed of the wind flow.
    - Wind flows parallel to isobars or contours.
    - The more closely spaced the isobars or contours, the stronger the pressure or contour gradient and therefore the stronger the wind.

EVALUATING WIND DIRECTION AND RELATIVE SPEED



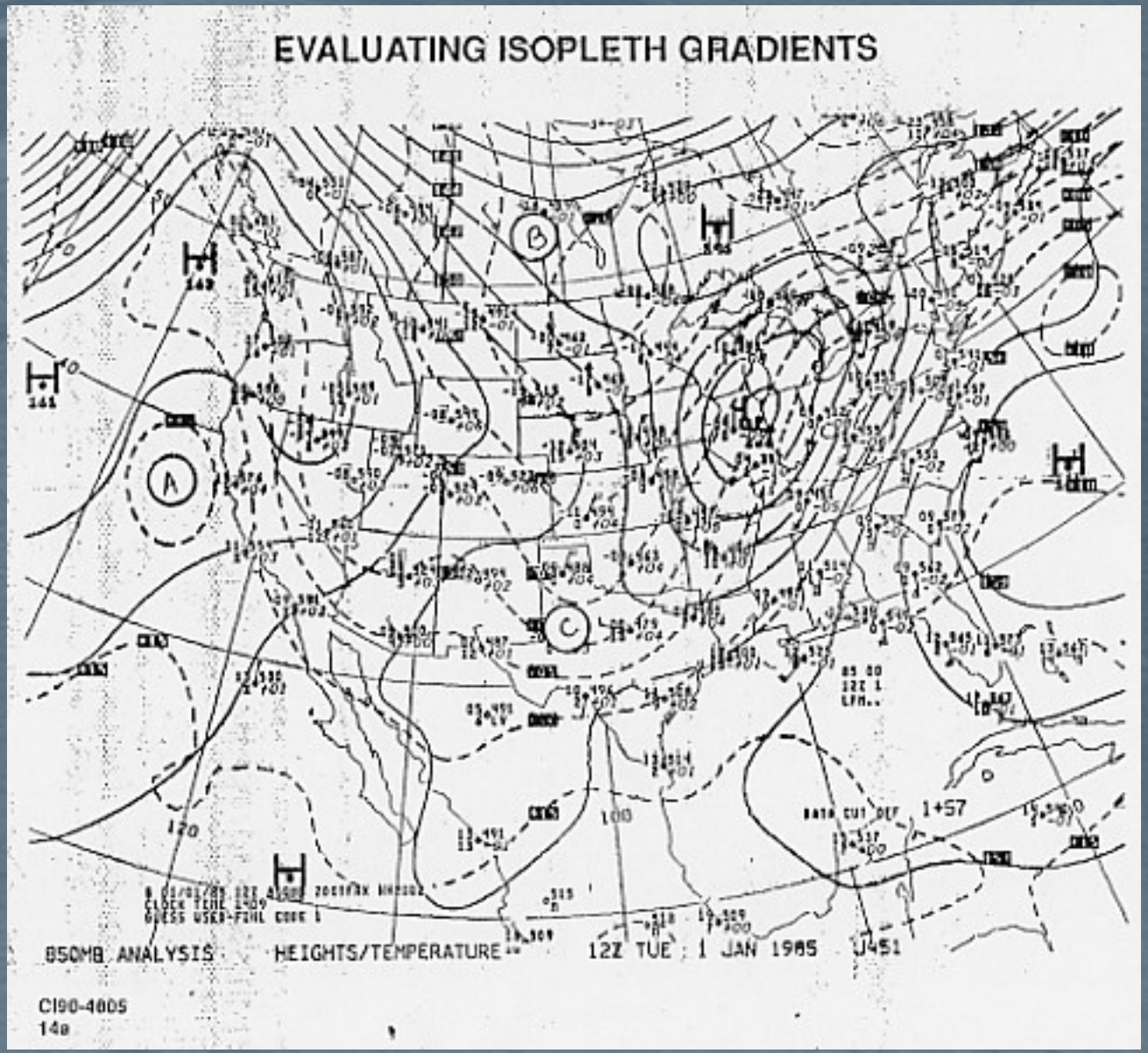
Determine the type and

Advection

- Example
  - Evaluate the wind direction at each point (A - W; B - NE; C - S)
  - At which point is the wind speed the greatest? (C)

Advection

- Step 2. Evaluate the gradient of the quantity being advected.
  - Based on spacing of isopleths (lines of constant values of a given quantity)
  - Or based on values of plotted stations
  - Gradient terminology
    - Strong/tight
    - Weak/loose



Determine the type and

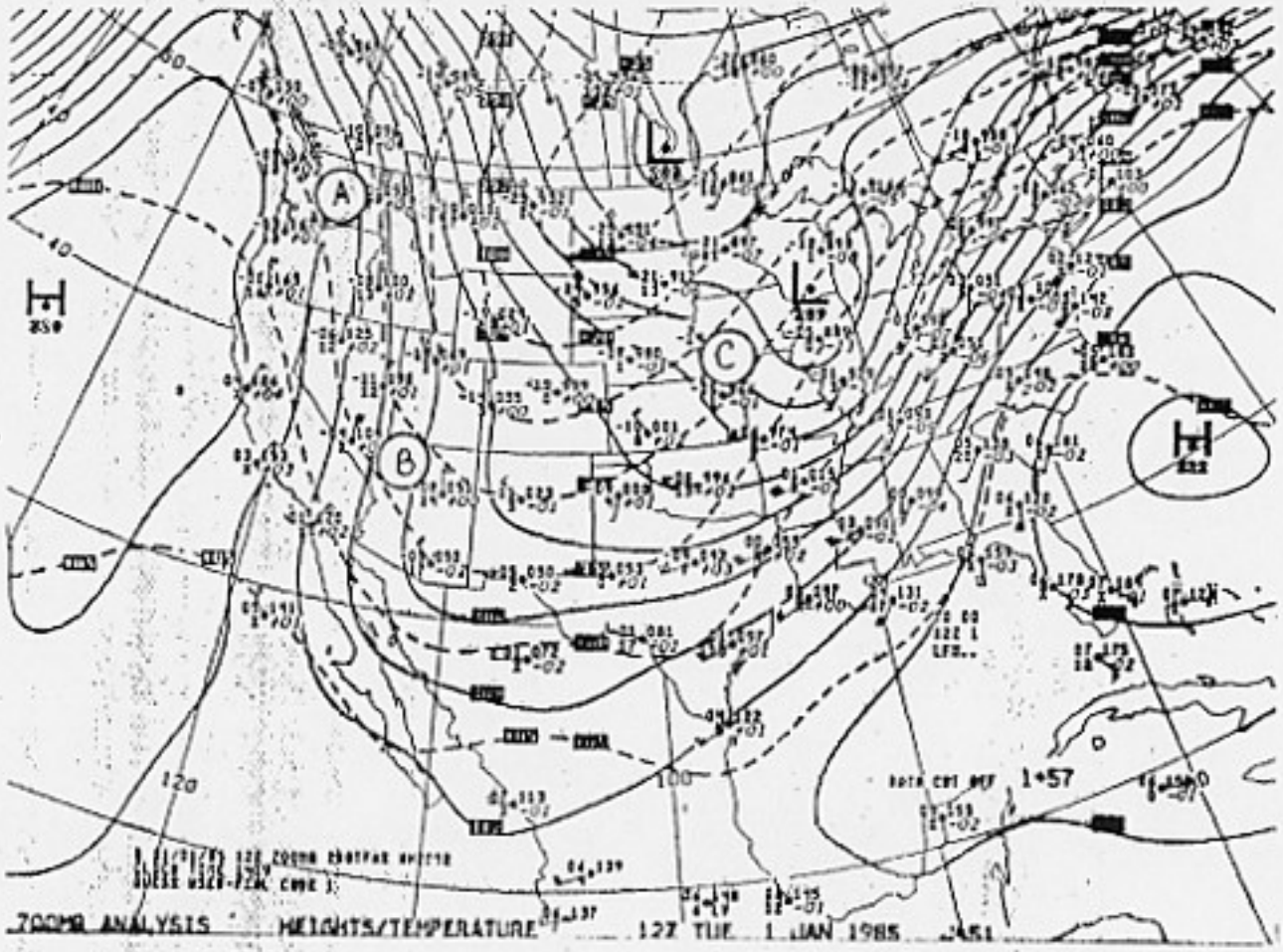
Advection

- Example
  - At which point is the temperature gradient the strongest? (C)
  - At which point is the temperature gradient the weakest? (A)

Advection

- Step 3. Evaluate the orientation of the isopleths relative to the isobars/contours.
  - The more perpendicular the isopleths are to the contours/isobars, the stronger the advection.
  - If isopleths are parallel to the contours/ isobars, there is no advection.

EVALUATING STRENGTH OF ADVECTION BASED PERPENDICULAR COMPONENTS OF WINDS



Determine the type and

Advection

- Example
  - –At which point are the isopleths and the contours most perpendicular? (C)
  - –At which point are they the least perpendicular? (A)

Advection

- Significant advection
  - “Significant" in magnitude is based on the 3 determinants identified previously.
  - "Significant" means there is some affect on the weather and this term is relative to the particular situation being examined.

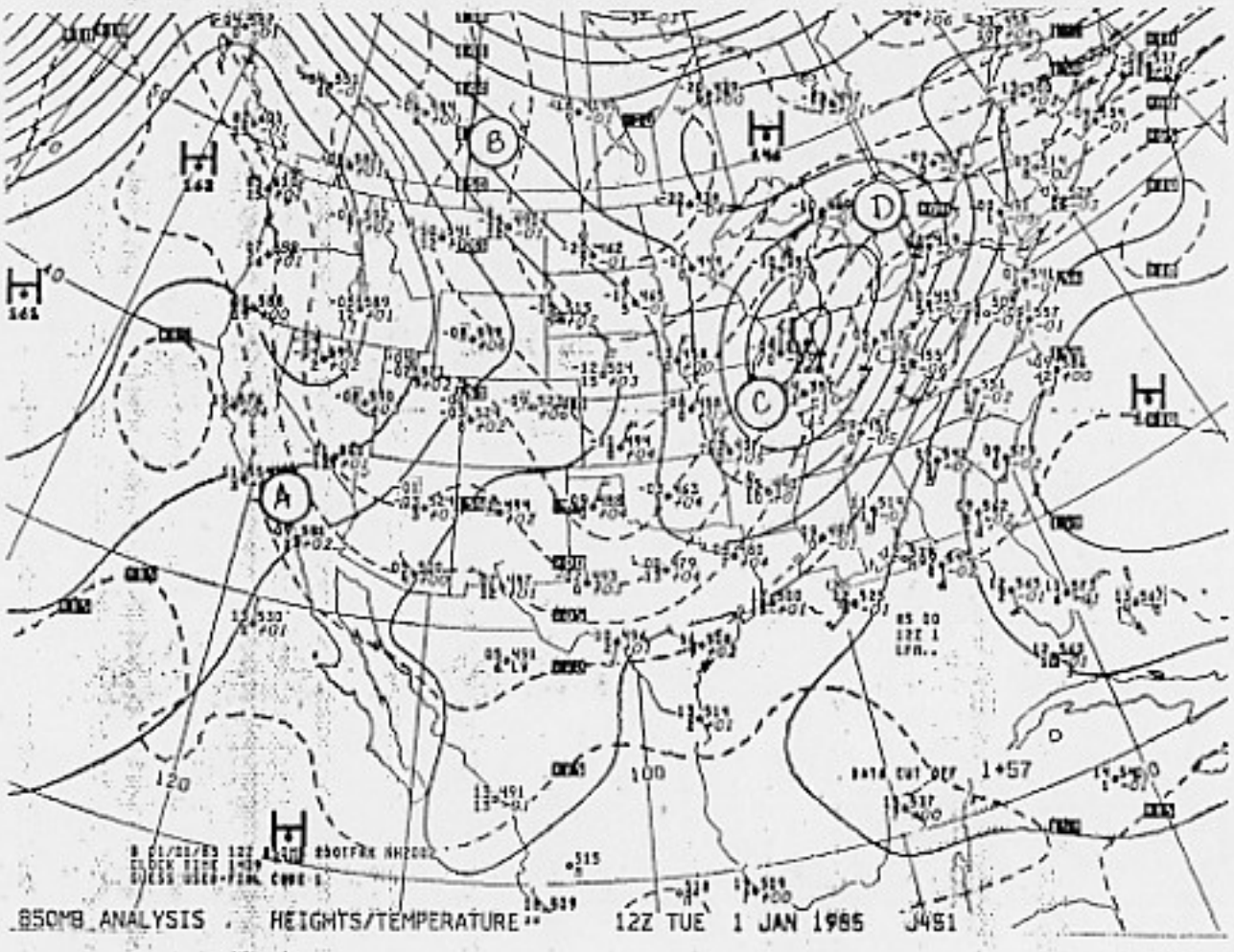
Types of Advection

- Temperature advection is the transport of air parcels of different temperatures into a region.
  - Warm air advection (WAA) - warm air is brought into an area previously occupied by cold air.
  - Cold air advection (CAA) - Cold air is brought into an area previously occupied by warmer air.

Types of Advection

- Evaluating temperature advection
  - Isothermal analysis of constant pressure charts
    - Isopleths used are called isotherms (lines of constant temperature).
    - Analyzed on constant pressure charts
    - Evaluation of isotherms
      - WAA - isotherms increase in magnitude upstream
      - CAA - isotherms decrease in magnitude upstream
      - Neutral - isotherms do not change in magnitude upstream

EVALUATING TEMPERATURE ADVECTION ON CONSTANT PRESSURE CHARTS



Determine the type and

Types of Advection

- Example: determine the type of advection at points:
  - A (CAA)
  - B (WAA)
  - C (CAA)
  - D (WAA)
- Example. based on the three steps in determining the strength of advection:
  - At which point is CAA the strongest? (C)
  - At which point is WAA the strongest? (D)

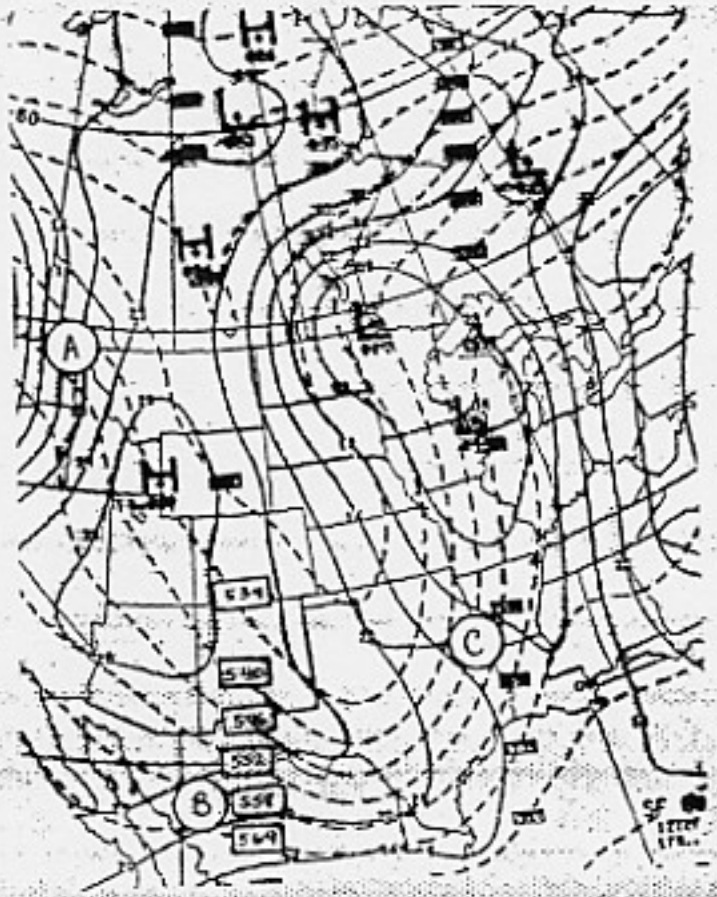
Types of Advection

- Evaluation of temperatures upstream on the surface chart (isotherms are not drawn)
  - WAA - temperatures increase upstream
  - CAA - temperatures decrease upstream
  - Neutral - temperatures do not change upstream

Evaluating temperature advection on surface charts

- Evaluation of thickness chart
  - Thickness is directly proportional to temperature.
  - WAA is indicated by increasing values of thickness upstream from the station.
  - CAA is indicated by decreasing values of thickness upstream from the station.

EVALUATING TEMPERATURE ADVECTION ON THICKNESS CHARTS



Determine the type and

Evaluating temperature advection on thickness charts

- Example. Determine the type of temperature advection at the following points:
  - A (WAA)
  - B (CAA)
  - C (CAA)

Atmospheric significance

- Significant in forecasting intensity trends of pressure systems
- Will stabilize or destabilize a layer

SFC to 700 warm over cold = stabilizing

850 to 500 cold over warm = destabilizing

SFC to 700 cold over warm = destabilizing

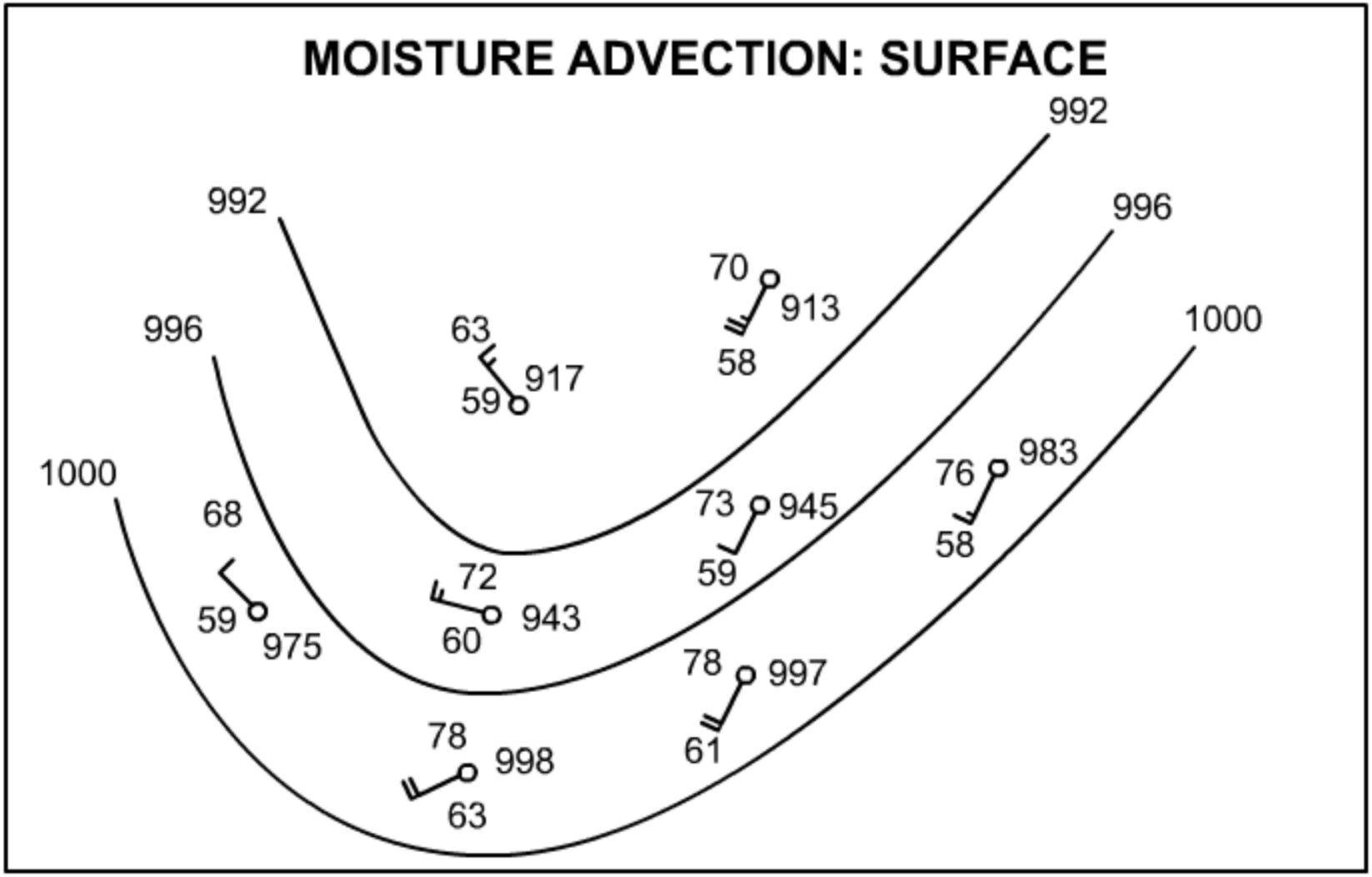
850 to 500 warm over cold = stabilizing

Moisture Advection

- Moisture advection - transportation of moisture by the wind
  - Moist air advection (MAA) - air of higher moisture content replaces drier air previously located in the region.
  - Dry air advection (DAA) - air of lower moisture content replaces air of higher moisture content previously in the region.

Evaluating Moisture Advection

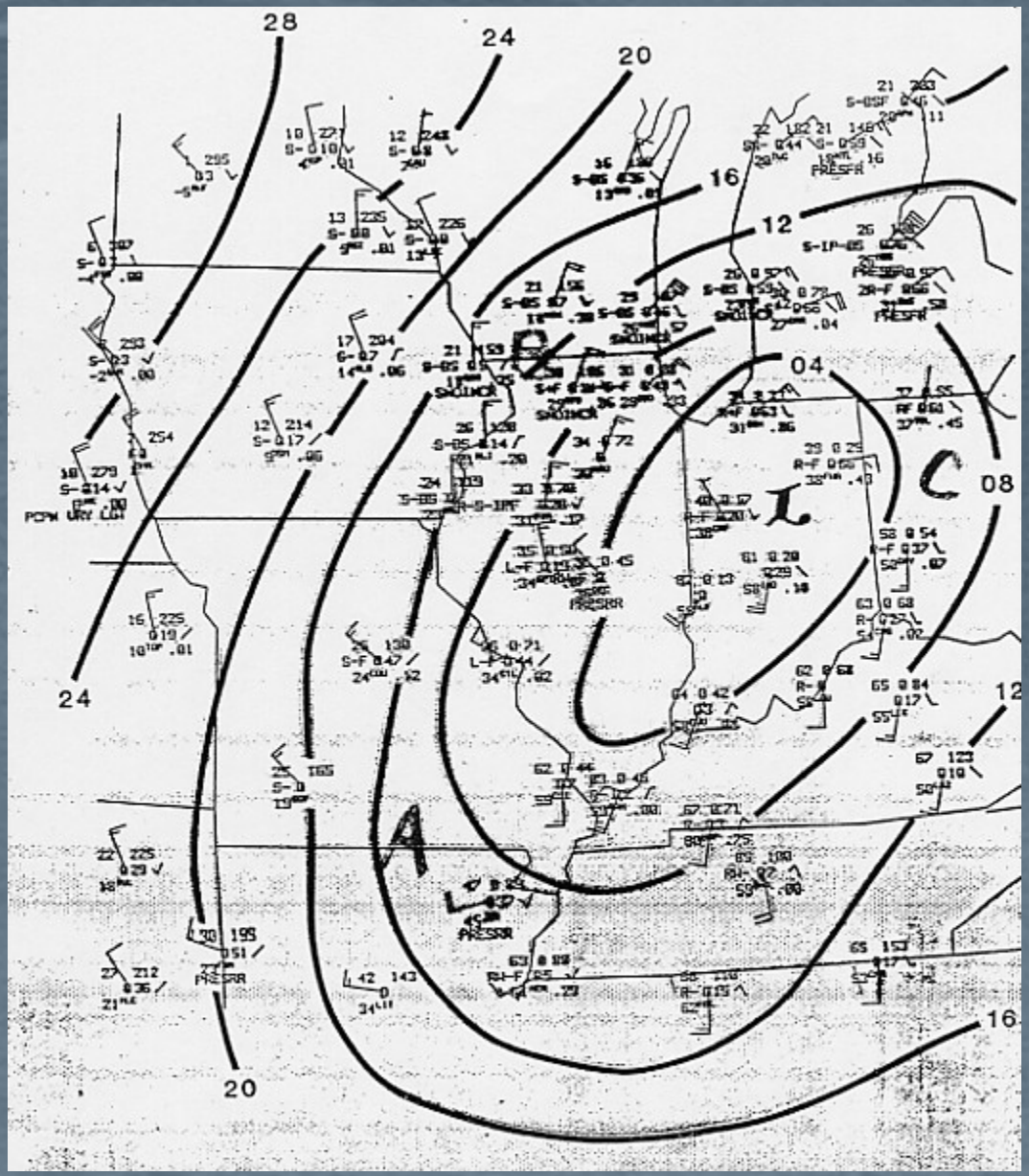
- Ways of evaluating moisture advection
  - At low levels (Surface and 850-mb charts)
    - Use dew points to evaluate (on the 850-mb chart, subtract the dew-point depression from the temperature to get dew-point value).
    - Evaluate values upstream
      - Higher values upstream indicate moist air advection.
      - Lower values upstream indicate dry air advection.



Determine the type and

Evaluating Moisture Advection

- Ways of evaluating low level moisture advection
  - Isodrosotherms (lines of constant dew point) can be drawn and used to evaluate moisture advection on the surface chart.
    - Example 1. Determine whether MAA or DAA is occurring at points:
      - A (DAA)
      - B (DAA)
      - C (MAA)

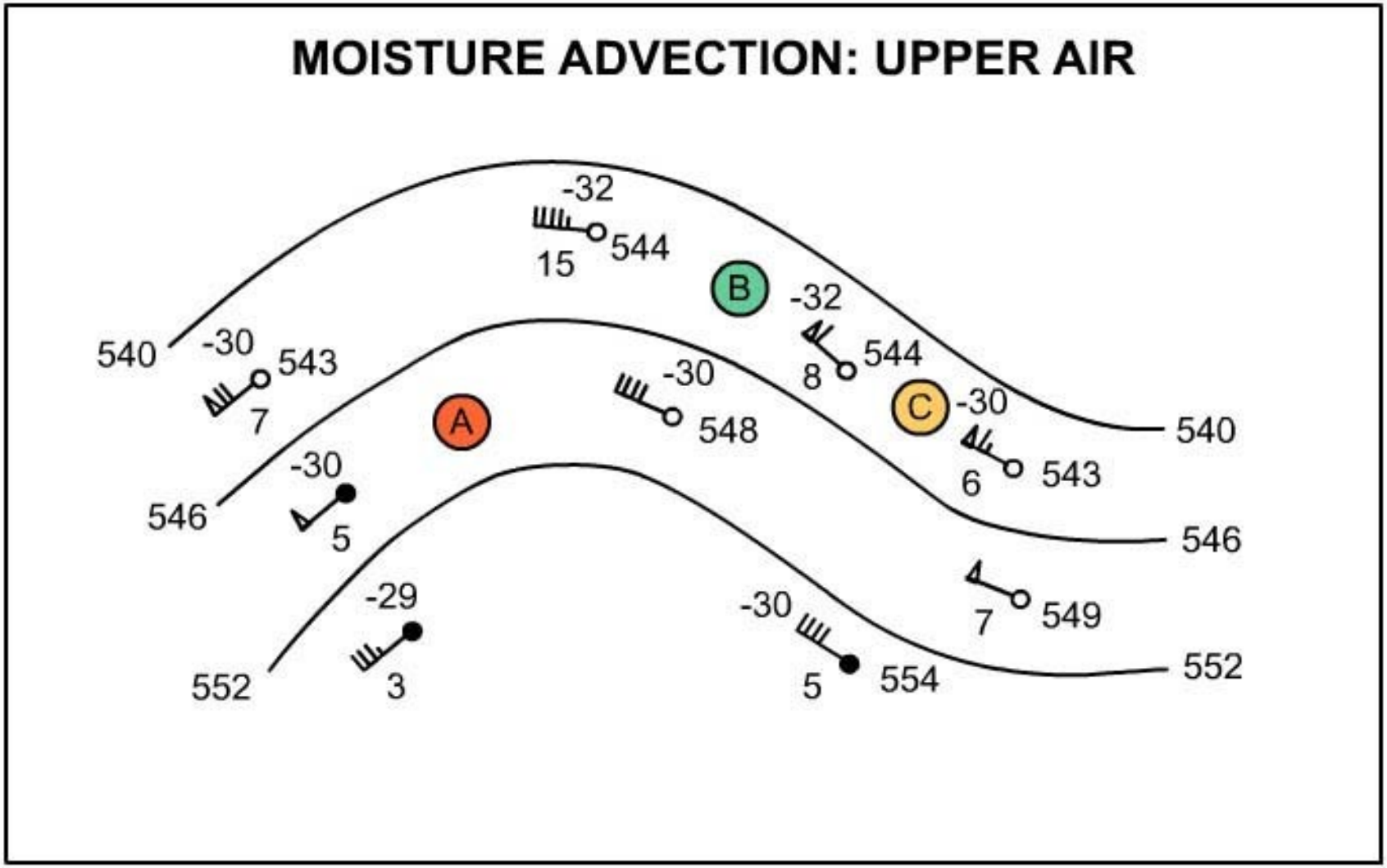


Determine the type and

December 2001

Evaluating Moisture Advection

- Upper levels (700-mb level and above)
  - Evaluate dew-point depressions.
  - Examine upstream values.
    - Lower values upstream indicate moist air advection (air is getting closer to saturation).
    - Higher values upstream indicate dry air advection (air is getting further from saturation).


MOISTURE ADVECTION: UPPER AIR
-32
15
544
B
-32
8
544
540
-30
543
7
A
-30
548
C
-30
6
543
540
546
-30
5
546
-29
3
552
-30
5
554
7
549
552

Evaluating Moisture Advection

- Example. Determine whether MAA or DAA is occurring at points:
  - A (MAA)
  - B (DAA)
  - C (DAA)

Evaluating Moisture Advection

- Other ways of determining moisture advection
  - Products from which winds are not specifically indicated can be used to determine moisture advection by using a time series.
  - Satellite pictures can be used to see clouds advecting into a region.
  - Horizontal Weather Depiction chart indicates areas of clouds.

Moisture Advection

- Atmospheric significance
  - Significant in forecasting intensity trends of pressure systems
  - Significant in severe weather potential (convection)
  - Significant in precipitation potential

- APPLICATION: Assign Review Exercise in WB-100
- EVALUATION: Administer and evaluate Appraisal 104a. Give the written test at the end of the unit.